Space Weather Technical Forecast

Issued on Thursday, 20 April 2023 at 12:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storms likely due to CME activity, with a lower risk of G2/Moderate or G3/Strong Storms on 20 and 21 April. Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with occasional C-class flares observed. There are currently five active regions on the visible disc. AR3282 is the largest region on the disc, located in the northwest quadrant. This has shown some minor growth of intermediate spots in recent hours. The remaining groups are small and simple, and appear to be either stable or in slow decay.

No Earth-directed CMEs have been observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1, showed ongoing weak CME effects. Wind speeds have been slightly elevated throughout much of the period, between 400-490km/s, and continue to show a declining trend towards background levels. Density was average or just above. Total magnetic field strength was at weak to moderate levels, currently near 10 nT. The north-south component varied moderately between +10/-7nT. The phi angle was initially positive (away from the Sun), but has recently become predominately negative (away from the Sun). Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was at background levels. The associated 24-hour integrated electron fluence was well below the Active threshold on a steady trend, with 1.43e6 integrated pfu observed at 20/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be generally Low, with a chance of isolated Moderate activity, mainly due to AR3282.

Solar Wind / Geomagnetic Activity: A CME may arrive at Earth on Days 1 or 2 (20 or 21 Apr), but confidence is low in the timing and impact of this feature. Otherwise, a coronal hole high speed stream may give elevated wind speeds on Days 3 or 4 (22 or 23 Apr).

Geomagnetic activity is forecast to be Quiet to Unsettled at first. Activity is likely to reach G1/Minor Storm levels (Kp5) either on 20 or 21 Apr due to the anticipated CME arrival, with a lower risk of G2/Moderate (Kp6) or G3/Strong Storm (Kp7) conditions. Effects will slowly decline through the following days.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to persist at background levels, although there is a slight chance of S1 or greater, mainly

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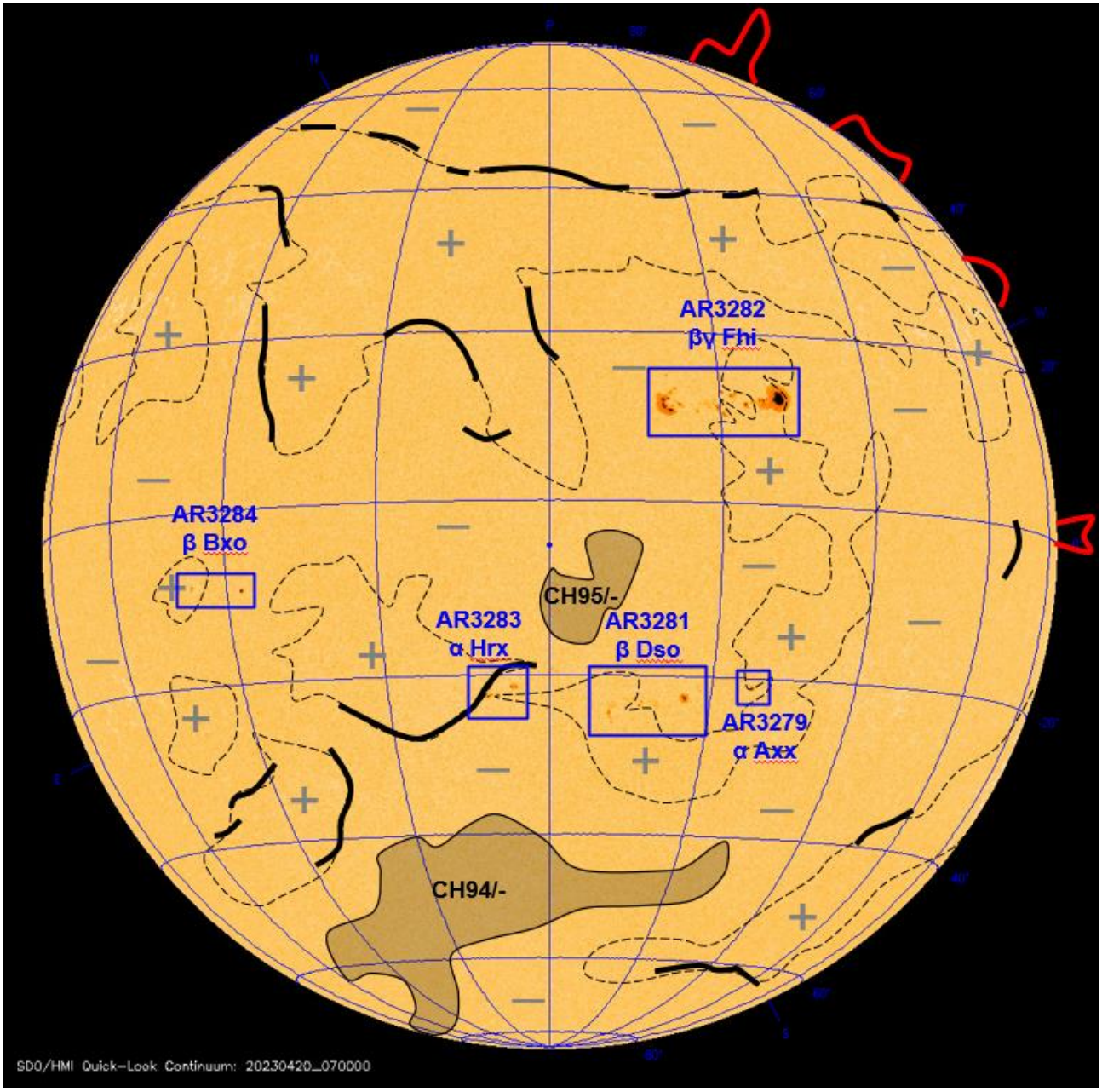
due to AR3282. High energy (greater than 2 MeV) electron flux is currently at background levels with little change expected throughout much of the period. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 20/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A faint CME halo from a large filament eruption late on 15 April is likely to affect Earth, arriving on either Days 1 or 2 (20 or 21 Apr). Confidence in the arrival time and geomagnetic effects is only moderate given the apparent diffuse signature of the CME in LASCO C2 and C3 imagery and limited STEREO A data for the event. There is a broad expected arrival window from early on 20 Apr until the end of 21 Apr.

Earth is currently in a slightly elevated but declining solar wind regime following the impact of the CME on 18 April. Solar winds should decline back to ambient levels ahead of the potential CME arrival on Days 1 or 2. The next high speed stream from CH94 or CH95 (both negative) is not expected to become geoeffective until Days 3 or 4 (22-23 Apr). CH94 is a high latitude feature so may not reach Earth. CH95 is more centrally located but is small, so wind speeds may only reach 450-550 km/s.

Geomagnetic activity is forecast to be Quiet to Unsettled at first. Activity is likely to reach G1/Minor Storm levels (Kp5) on 20 or 21 Apr due to the anticipated CME arrival, with a lower risk of G2/Moderate (Kp6) or G3/Strong Storm (Kp7) conditions. Effects will slowly decline through the following days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	60	30	10
Strong	G3	No	20	20	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1343	Full	Filament eruption	NW	342 km/s	20/1300 UTC +/- 12 hours	Low confidence in arrival time and impact.

Figure 2: MOSWOC Enlil and Ensemble, showing potential CME impact over the next couple of days, also, an increase in wind speeds later in the period, due to possible HSS from coronal holes.

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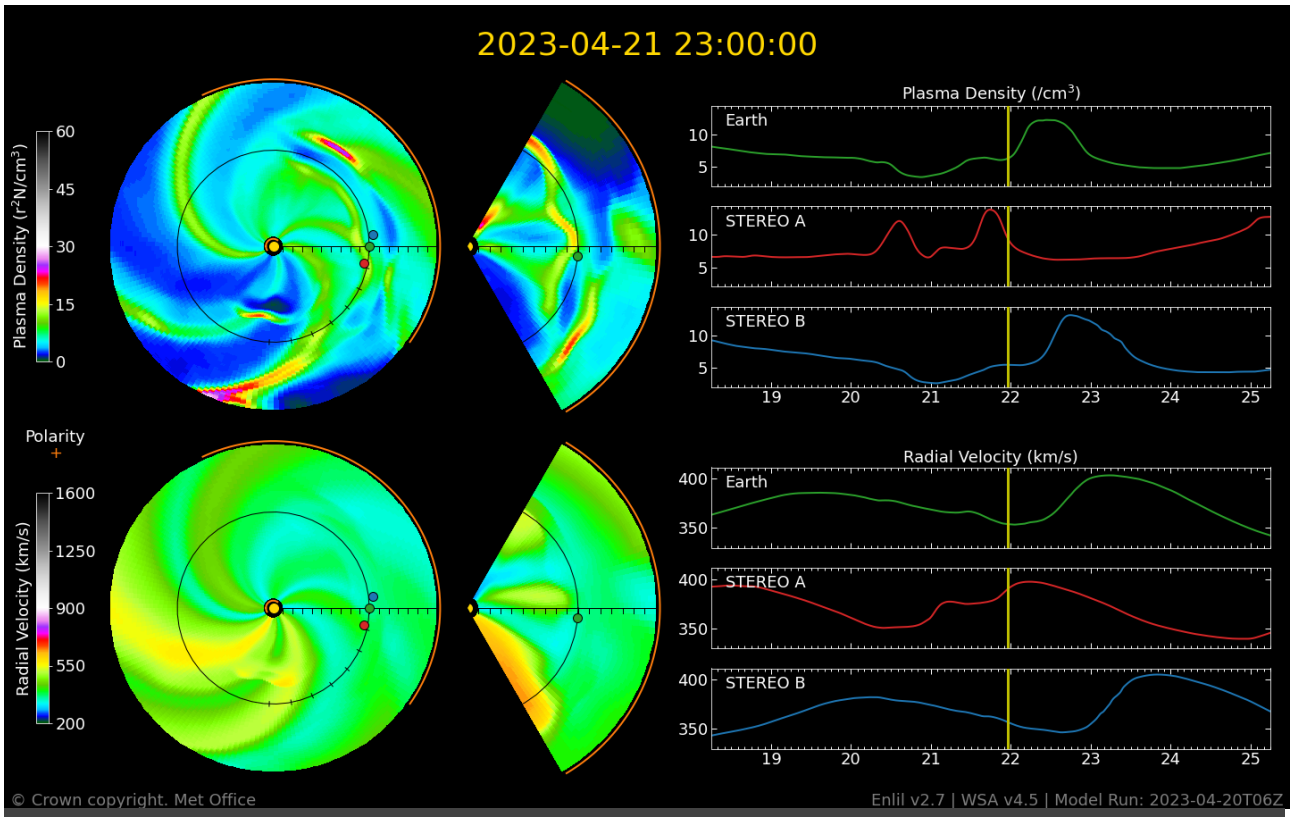

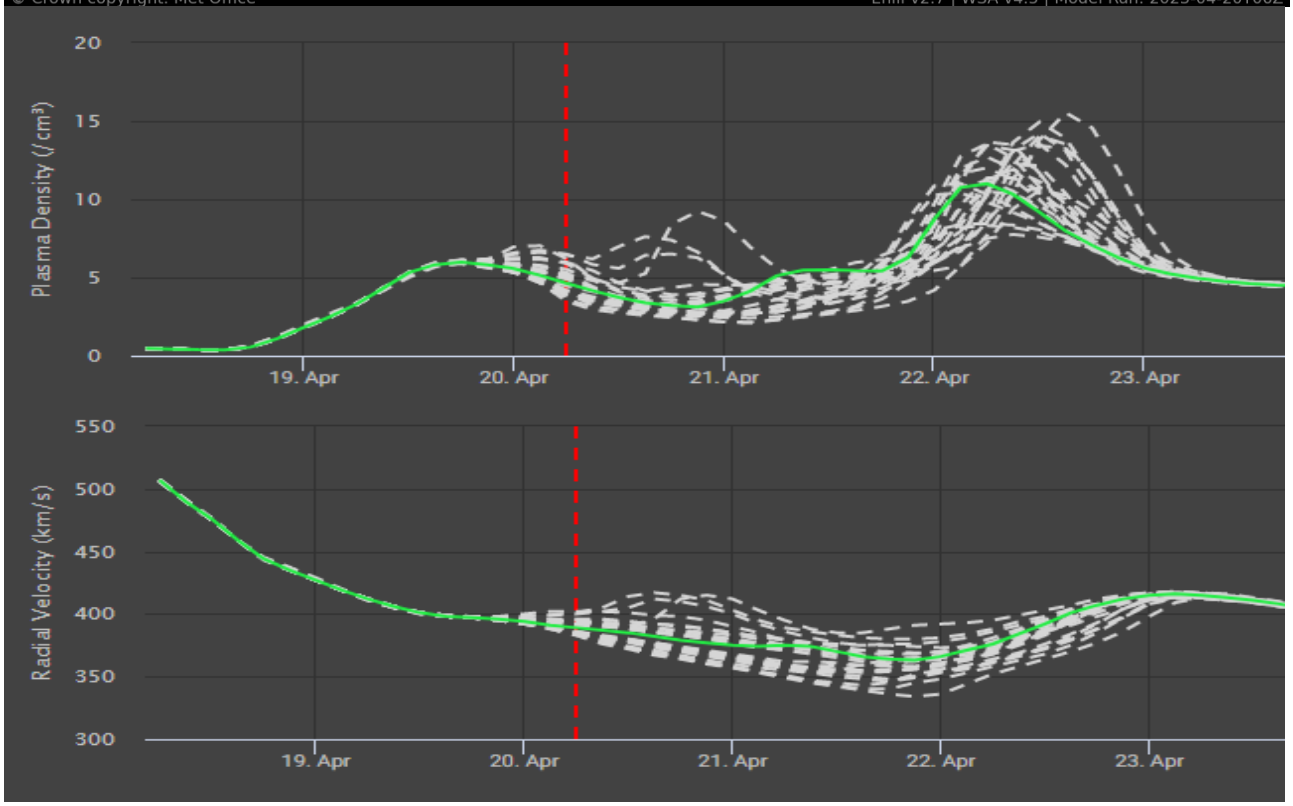

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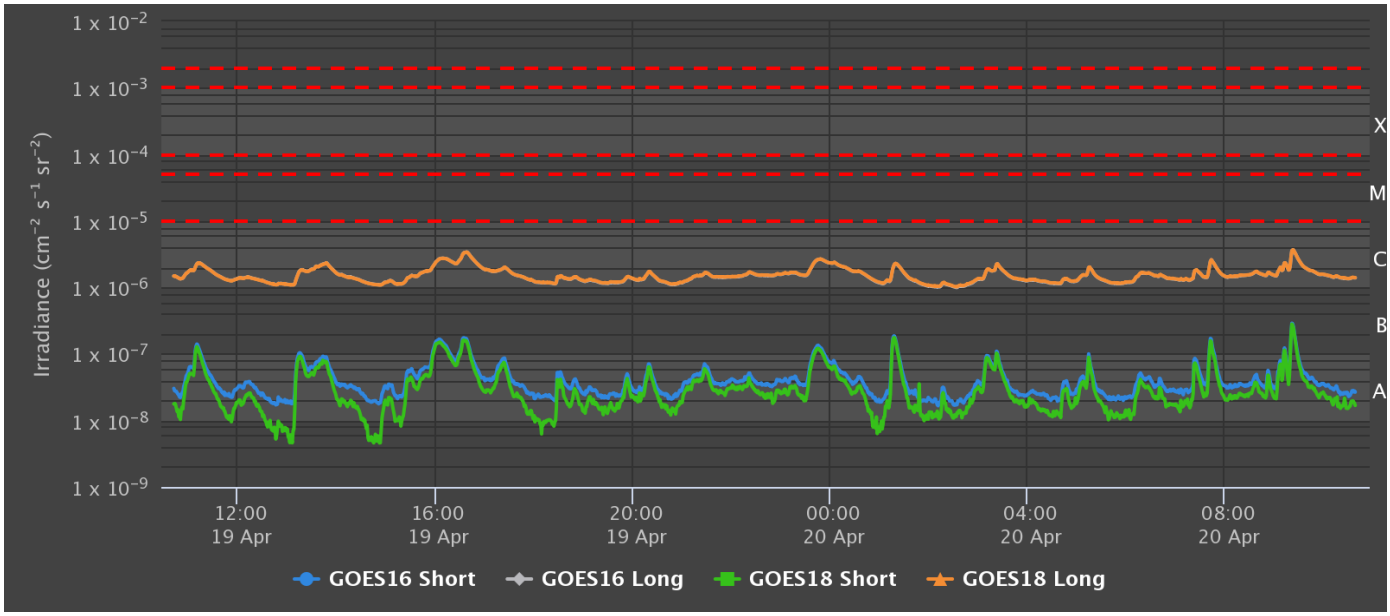
Radio Blackouts - X-Ray Flares:
There are currently five active regions on the visible disc. AR3282 (Fhi/Beta-Gamma) is the largest region located in the northwest quadrant. This region has shown some minor growth of the intermediate spots in recent hours, which will continue to be monitored for any potential 'delta' spot emerging. The remaining groups are small and simple, and appear to be either stable or in slow decay.

Whilst there is some evidence of a possible new region to rotate onto the disc in the next day or so, it cannot be assessed at this time. As such, the probabilities have been kept flat through this period, until any new regions become visible and can be analysed. Solar activity is therefore most likely to be Low, with a chance of becoming Moderate with any isolated M-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES X-Ray Flares



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16, is currently at background levels. There is a slight chance of an increase to S1 or greater, should any larger flares occur, mainly from AR3282. The risk increases slightly as this region moves further into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Recent CME effects may have increased electron density in the radiation belts. However, enhanced geomagnetic activity due to a further expected CME arrival either on Day 1 or 2 (20 or 21 Apr) is likely to suppress any brief increase in electron flux that may arise. It is possible that electron flux may start to rise towards the end of the period as CME effects wane, although there is also the possibility of a coronal hole high speed stream at this time which means that flux levels are most likely to stay suppressed through this period.

Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold throughout due to the forecast geomagnetic enhancements. MOSWOC REFM is forecasting an increase in fluence, although below Active levels, but this model won't be taking account of the anticipated CME arrival and is therefore unreliable at this time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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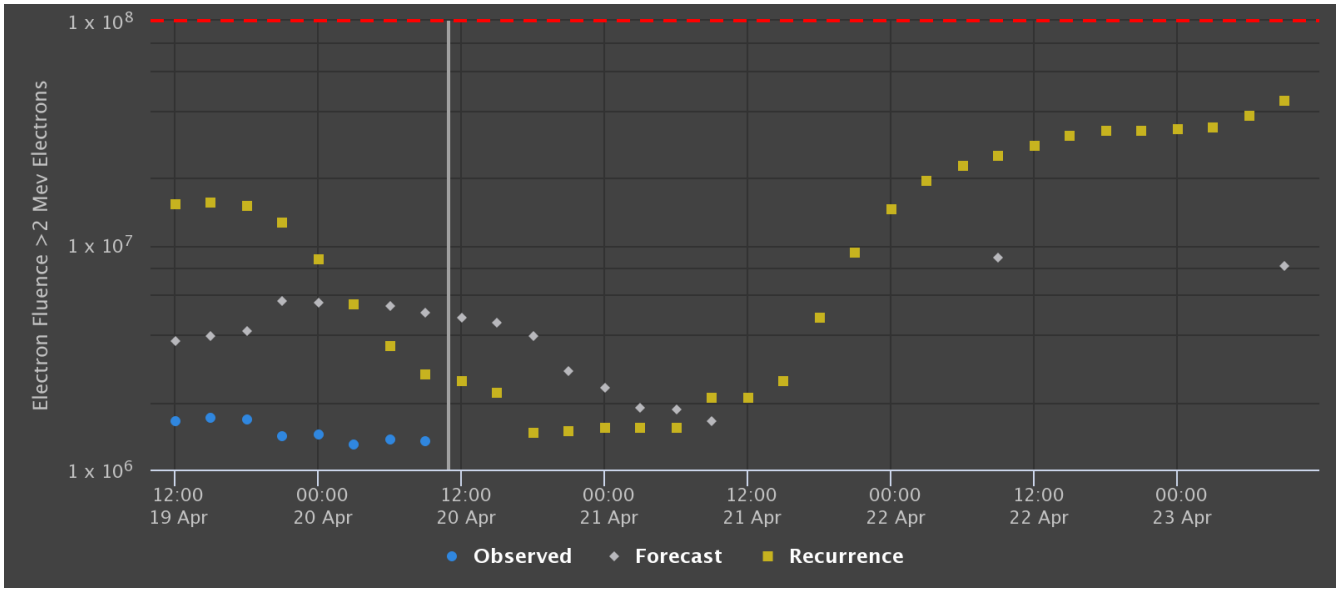
Figure 4: MOSWOC REFM showing an increase in fluence, below Active, but this will not be taking into account the anticipated CME arrival.



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